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MEAT MICROORGANISMS

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by

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EFFECT OF IONIZING RADIATION ON MEAT MICROORGANISMS

The inactivating effect of radiation on microorganisms creates extensive possibilities for using this form of energy as a new method for preserving food.

The use of radiation for treatment of raw meat and meat products has great significance.

Along with the use of high doses of radiation, which insure complete suppression of microorganisms of preserved meats, positive results over long periods of preservation of meat products may be achieved when using small doses of radiation of the order of several hundred thousand rad., without causing any changes in the organoleptic properties of the meat and at the same time promoting significant retardation of the viability of spontaneous microflora of the meat.

It is now already widely known that irradiation of meat at doses from 0.2 mrad. and higher inhibits the growth of microorganisms during subsequent storage in a refrigerated or frozen state dependent on the dose of radiation for 2 -- 5 and more weeks.

In the majority of investigations authors have primarily studied the effect of radiation on the repression of growth of microorganisms at lowered temperatures. This is explained by the fact that the combination of radiation for storage at low temperatures creates the most effective conditions for prolonged period of storage of the meat.

Nevertheless in a series of cases the storage of irradiated meat without refrigeration may have important practical significance. Therefore, in our work research was carried out on the mechanisms of growth and development of spontaneous microflora in irradiated meat at the usual room temperature of storage: 20 -- 22°C.

In order to create uniformity in the microbiological behavior of the environment meat for the experiments was ground to the condition of sausage meat and after thorough mixing was packaged in 50 g lots in sterile glass flasks with cotton stoppers. The packaged meat was irradiated at doses of 0.1; 0.2; 0.3; 0.5; 0.6; 0.8; 1.0 mrad.

C_{o}-60 was used as the radiation source. After irradiation the specimens were stored at room temperature and underwent microbiological analysis after a determined amount of time. The number of bacteria retaining the ability to propagate was determined by feeding the meat after corresponding dilution in petri dishes on meat-peptone agar.

Estimate of growing colonies was carried out after 2 - 3 days of thermostatic growth at 30°C. Average results of the series of experiments are presented in Table 1.

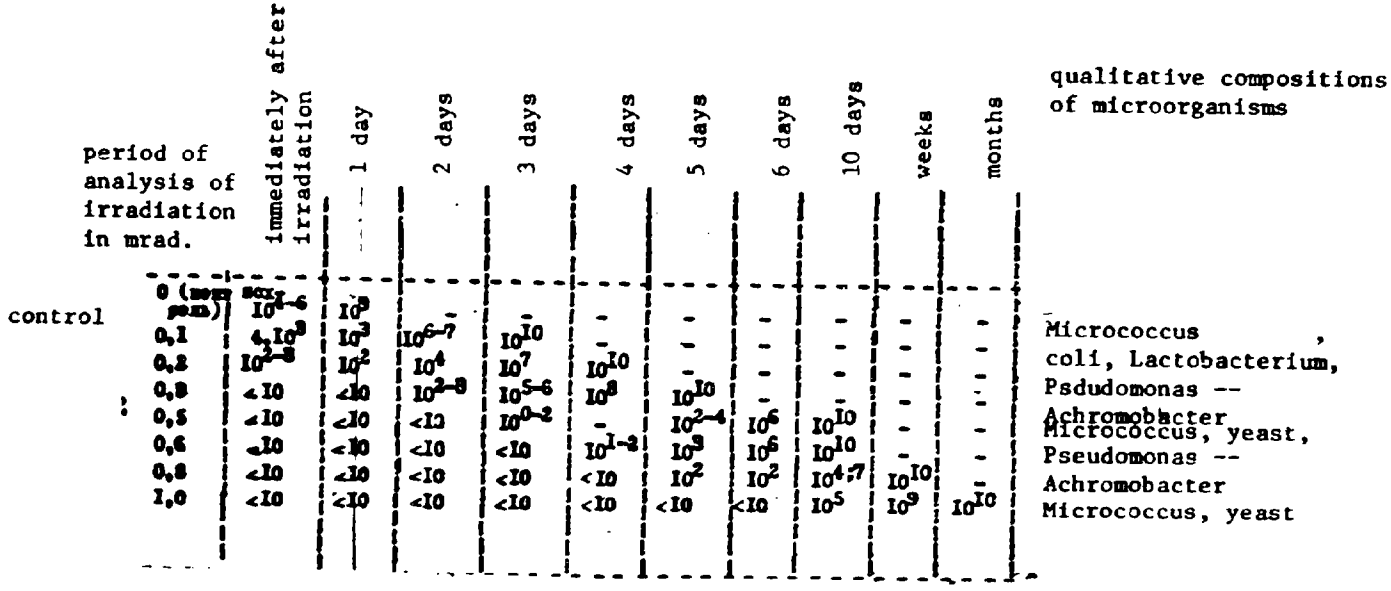
As can be seen from the data in Table 1, varying degrees of reduction of feeding ability of the ground meat was observed dependent upon the amount of the dose of radiation. Whereas in control, in nonirradiated samples of meat the feeding ability was calculated at hundreds of thousands and millions of cells, immediately after irradiation at a dose of 0.1 mrad. the number decreased to several thousand cells per gram of meat, at a dose of 0.2 mrad. in the limits of hundreds and thousands of cells, and beginning with a dose of 0.3 mrad. The quantity of microorganisms decreased so much that in nutritive agar bacterial growth was not observed.

Sometime after irradiation the number of microorganisms in the irradiated samples began to increase and reached a quantity of 10^{6-7} cells/g of product in the control less than after 24 hours; at a dose of 0.1 mrad. after 2 days; 0.2 and 0.3 after three days; 0.5 -- 0.6 after 7 -- 8 days; 0.8 after 10 days; 1.0 after 10 -- 12 days.

On subsequent days when the feeding ability increased to billions and tens of billions of cells per g of ground meat, storage of the samples ceased although specific spoilage of the meat was reached only in nonirradiated ground meat; in irradiated samples, despite massive feeding, physico organoleptic signs of spoilage (turning rancid, turning green, turning slimy, etc.) were not observed.

Table 1

Dynamics of Microbiological Process
In Irradiated Meat



A similar phenomena is explained by changes not only in the quantitative, but also in the qualitative composition of spontaneous microflora of irradiated ground meat under the influence of radiation. Although in control, nonirradiated ground meat the basic species causing spoilage were noncryptogams of decay bacilli of the *Pseudomonas -- Achromobacter* group, in the irradiated samples, beginning with a dose of 0.2 mrad. this group of bacteria was completely suppressed as a result of its low radio resistance. Principally, microflora of irradiated ground meat are uniform and are radio-resistant species of white and nonpigmented micrococci, yeast, and less frequent bacilli.

In nonirradiated meat products these species of microorganisms have secondary importance, since in the process of storing meat they are replaced by more rapidly propagating noncryptogam bacilli of the Pseudomonas -- Achromobacter group. Noncryptogam bacilli, possessing active proteolytic enzymes, cause deep seated decaying decomposition of the protein components of the meat, accompanied by the appearance of clear organoleptic signs of spoilage.

Upon radiation treatment, as a result of inactivation of bacterial flora the micrococci and yeast obtain preferential development.

The absence of clear signs of spoilage in irradiated ground meat, even upon massive feeding with yeast and cocci, indicates both the complete biochemical inertness, and the extremely weak appearance of biochemical activity of these species on a meat substrate.

In order to solve these problems, experiments were carried out in a study of proteolytic and lipolytic activity of the most characteristic species of radio resistant micrococci and yeast, which are prevalent in the microflora of irradiated ground meat. Biochemical activity of untreated bacilli, which are rather characteristic for certain types of irradiated meat products, was also studied.

The proteolytic activity of radio resistant microorganisms was studied according to their ability to cause the breakdown of meat-peptone gelatin and according to the formation of transparent zones around the colonies in an agarized meat suspension as a result of peptonization of proteins according to the Pohia method.

Additional activity of the cultures studied was determined by the Eykman method according to the formation of white zones around colonies as a result of the addition of fat during feeding on the petri dishes with beef fat.

The ability of the microorganisms for protellysis and lipolysis was determined during direct feeding of irradiated ground meat on nutritive medium, and also after preliminary purification of the cultures investigated at the 2 -- 3 generation. The inoculations were sustained over the course of 15 -- 30 days at a temperature of 22°C, as the nearest to room conditions of storage of meat, and were inspected daily. Total activity was estimated for the entire period of development.

In Table 2 the generalized results are presented of determination of activity of microorganisms from irradiated ground meat.

As can be seen from the data in the table, among the microorganisms studied the cryptogam bacilli possess relatively high proteolytic activity; in the cocci capacity for proteolysis was markedly weaker. Yeast, either did not possess proteolytic activity at all or expressed it to a very weak extent.

The ability to break down fat was established in certain strains of yeast and bacilli. Among the micrococci weak lipolytic activity was noted on the 12th day in one of the strains isolated from ground meat irradiated with a dose of 0.3 mrad. In the active strains of yeast and bacilli the lipolytic activity began to appear on the 4th to 10th, and sometimes on the 15th day of growth.

On the basis of the data obtained one must assume that even the presence of micrococci in the residual microflora of irradiated meat products certain proteolytic breakdown of the protein substrate can occur. Radio resistant yeasts are practically incapable of causing proteolysis of meat, but may effect the process of decomposition of the fat component. Although cryptogam bacilli are not typically represented in the residual microflora in irradiated raw meat, in other types of irradiated meat products (for example, prepared culinary dishes) they may cause proteolytic and lipolytic spoilage as a result of their comparatively high activity.

Table 2

Determination of activity of microorganisms, irradiated ground meat

and number of strain	where isolated	diameter of zone around colony in cm		
		proteolytic activity		lipolytic activity (in meat fat
		in meat agar	in gelatin	
	from ground meat irradiated with 0.1 mrad.			
strain I	[illegible]	2.5	++	[illegible]
2	" " 0,2 "	2	++	[illegible]
3	" " 0,3 "	2,5	+	[illegible]
4	" " 0,5 "	0	0	0
5	" " 0,6 "	I	+	0
I	" " 0,8 "	0	0	I
2	" " 0,3 "	0,2	+	[illegible]
3	" " 0,5 "	0,I	+	I,2
4	" " 0,6 "	0	0	[illegible]
5	" " 0,5 "	0	0	2
I	" " 0,8 "	2	+++	I,5
2	" " 0,5 "	6	+++	0
3	" " 0,6 "	8	+++	0
4	" " 0,8 "	5	+++	I
5	" " I,0 "	8	+++	I

key

+++	strong	breakdown of gelatin	
++	"	weak	" "
+	"	very weak	" "
0	"	absence	" "

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13. ABSTRACT

The inactivating effect of ionizing radiation on microorganisms in raw meat has been studied during storage of ground meat at room temperature (20 -- 22o). Meat was irradiated with doses of 0.1, 0.2, 0.3, 0.5, 0.6, 0.8 and 1.0 mrad. from a Co^{60} source. >Microbiological analysis was performed at various intervals after irradiation- and the number of cells of each type was determined. Proteolytic and lipolytic activities were also determined for each strain. It is concluded that some proteolytic breakdown of the protein substrate can occur if micrococci are present in the residual microflora of irradiated meat products. Radio resistant yeast are practically incapable of proteolysis, but can effect the process of decomposition of the fat component. Cryptogam bacilli are ot typically present in irradiated raw meat, but in other types of irradiated meat products they can cause proteolytic and lipolytic spoilage.

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